

# The Dalles Oil Transformer T2 Phase B Spill January 15th 2004

Date of Assessment

Feb 2/3 2004

Personnel Conducting the Assessment

Gary Sanford BPA  
Mitch Samuelian BOR  
Jim Blankenship BOR (ret)

## **I. Overview**

On January 15, 2004 a leak was detected on Transformer T2 phase B (T2B). The oil leaked from the transformer through the cooling water lines and into the secondary containment around the transformer. The secondary containment for Phase B has open penetrations to lower station levels and an improperly sealed expansion joint. Oil leaked out of the secondary containment barrier and subsequently entered the power plant and the Columbia River. Oil continued to enter the Columbia River until January 17, 2004.

This assessment is intended to reconstruct the mechanical sequence of the event access operations, maintenance and environmental actions taken leading up to and during the event. In addition, recommend actions, which would have minimized or prevented the oil spill, and make recommendations intended to prevent recurrence.

## **II. Detail of Event**

On October 29th of 2003 transformer T2 phase A (T2A) faulted 60,000 KA to ground (more than likely due to a failure of the oil cooler). The transformer had been tested earlier that year and no significant water was detected. However, after the fault, water was detected in the phase A transformer Oil. The phase A transformer cooling oil was drained into the transformer oil storage tank. Per plant staff, transformer bank T2 (built in 1941) was originally a Bonneville Dam transformer but was installed at the Dalles in the mid 1970's. This transformer has an oil water cooler that is installed inside the transformer. When the transformer was installed the copper cooling water lines were connected to the iron pipe cooling water distribution header with PVC piping to provide electrical isolation. Sometime later the cooling water to T2B and T2C was isolated.

In early January 2004 a severe cold spell lowered Plant ambient temperatures below 32F. This caused freezing of the isolated but not drained T2B and T2C cooling water pipes breaking about 5 PVC nipples in T2B and 3 PVC nipples in T2C (other piping is also damaged within the T2C cooling water distribution header). It appears that the freezing also caused failure of the internal cooling water heat exchanger tubes. This resulted in the release of oil from the transformers through their damaged cooling water piping into their secondary containment starting sometime the evening of January 14th.

On January 15<sup>th</sup>, Thursday, at approximately 6:30 AM plant maintenance staff found oil leaking in the power plant (~60 gal on the 6th level). The control room was notified at 0700 AM. Plant staff traced the oil leak up through 4 floors to T2B and found oil in the secondary containment. The oil had entered the plant from unsealed piping penetrations in the secondary containment *with lips* extending 3~4 inches above the secondary containment floor. This prevented the oil level in the secondary containment from becoming greater than 3~4 inches. Oil was also found in the gate slot next to T2B. This oil had leaked through the improperly sealed expansion joint seal onto the deck and then flowed through drainage holes into the gate slot. The oil was isolated in the gate slot from the river. The staff initiated isolation and cleanup process of the oil. It was initially thought that only a small amount of oil had leaked into the river because oil had drained into the power plant via the open penetrations or the gate slot via the expansion joint

leak and was effectively isolated in the forebay. The snow cover on the roof masked the fact that a significant amount of oil was present and was traveling down the roof drain into the river.

At 8:48am oil was reported in the spillway tail water area. Staff initiated a search for the source of oil. Boom was deployed in the river by dusk that evening. The secondary containment for T2B and T2C were cleaned on Thursday. Staff continued to search for the oil source and could not find where the oil was coming from. Saturday a large quantity of oil was located on the roof adjacent to the transformer bank. A dam was placed around the roof drain, which stopped the oil release to the river via the roof drain system. Leakage from the combined roof drains had exited the facility and drained directly into the river in the tailbay near the effluent from Turbine 5.

The roofing rocks between the secondary containment and roof drain were saturated with oil. Absorbents were used to remove oil from the roofing rocks. The oil soaked roofing rocks were then removed and disposed of by Foss Environmental. Absorbents were used to clean up oil off of the rock and the rock was removed and disposed of.

The staff continue oil cleanup and quantified the amount T2B captured oil as follows:

- Secondary containment and gate slot (747 gallons)
- T2B transformer 1st trip vacuum truck (2,805 gallons)
- T2B transformer 2nd trip vacuum truck (245 gallons)
- Residue inside the transformer area and piping is estimated at (200 gallons)
- Power plant (200 gallons).

This is a total of 4,197 gallons recovered out of approximately 5500 gallons of total capacity (nameplate capacity is 6000 gallons) this leaves 1303 gallons of which:

- 638 gallons were recovered from the river
- An unknown amount of oil was captured in the roof rock
- The rest is presumed to un-recovered from the river downstream of the dam

### **III. Contributing items:**

- A. Age and condition of transformer and cooling water system.
- B. Transformer inspections are only once per week and they may be omitted if busy. (Omitted on the week of Jan 11-17).
- C. Expansion joint passes through secondary containment and had not been adequately maintained or sealed.
- D. Unsealed piping penetrations in secondary containment sump.
- E. Secondary containment drains to river and should be diverted to an internal oil water separator.
- F. The combination of rock on the roof and the covering of 1 ft of snow masked the fact that oil was on the roof.

- G. The waterside of the transformer cooling system was not drained when it was isolated.
- H. Cold weather plan does not address isolated transformers.
- I. Cooling water isolation valves were stuck and could not be operated.
- J. The transformer storage tank level gauges do not work and they did not have an inventory of their current capacity.

#### **IV. Actions That Would Have Lessened the Event:**

- A. Identification of the spill during operator rounds earlier in the event.
- B. The shutdown of generation would have limited the spread of oil down stream.
- C. Installation of secondary containment boom during maintenance.
- D. Pre-stage boom at Bingen marina, Spring Creek Fish Hatchery and Dalles Boat Basin.
- E. Oil spill training of crews should include hands on inland water oil spills training.
- F. Oil spill equipment should be staged and ready to be used.
- G. Ability to perform an oil spill inventory earlier than 6 days into the event.
- H. Investigating the entire length of the leaking expansion joint seal following initiation of the event.

#### **V. Recommendations:**

- A. Inspect secondary containment sumps for proper isolation/sealing of drains, expansion joints and piping penetrations. Consider rerouting secondary containment to oil water separator.
- B. Recalculate secondary containment sumps to ensure they meet EPA capacity requirements.
- C. Pre-stage containment boom on open trailers and absorbents on closed trailers.
- D. Initiate operator log readings and secondary containment inspections on transformers each shift to include actual measured level as found on gauges.

- E. Deploy containment boom up and downstream of units during annual or other oil spill risk maintenance.
- F. Add BPA, Tribe and local entities to notification list on SPCC.
- G. On SPCC 13.C needs to be rewritten to ensure that contracting process does not stop the cleanup process from going forward.
- H. Inspect all non-conducting dielectric cooling water connections and consider replacing them with non-conducting dielectric flanges, which are ridged.
- I. Include draining transformer-cooling water piping when isolating for maintenance.
- J. Replace T2 transformers and consider replacing oil water heat exchanger with double wall tubes.
- K. Fix the tank level gauges on the clean and dirty transformer oil storage tanks and record level readings each shift.
- L. Permanently install the plugs in the secondary containment for transformers and remove liquid buildup by pumping.
- M. The Corps should evaluate the command and control process, communications and interactions with external entities.

## **VI. Summary of Findings**

- A. Poor material condition of transformer cooling water piping and valves. (Inoperable isolation valves and corroded piping)
- B. Infrequent and non-specific operator required inspections and improper isolation of the transformers and secondary containment. (Weekly, no level readings and omitted readings)
- C. Poor oil containment design of the transformer T2 secondary containment, cooling water system and adjacent roof drains. (All discharge straight to the river)
- D. Inability to perform an oil mass balance with installed plant equipment. (Inability to rapidly determine by inventory how much oil was unaccounted for)
- E. No installation of oil containment boom in the forebay and tailbay prior to the T2 maintenance by plant staff.
- F. The plant environmental staff addressed the federal, state and other public communications and coordination, while at the same time controlling and investigating the event. Facility management and the District office should have provided additional timely onsite support for the environmental coordinator to reduce the workload and allow a more focused effort on the event.
- G. There was poor communication between the environmental coordinator and the maintenance staff.

## VII. Conclusions


- There was a failure of 2 mechanical barriers that led to the oil reaching the river. The age, condition and physical state (cooling water not drained) of the transformer and the condition of the secondary containment were the major contributors to the event.
- The response of the facility staff was in accordance with the established spill plan and having the cleanup in progress within 2 hours was excellent.
- The initial diagnosis of the amount spilled was based on the mindset that the event had been isolated and the focus was on the recovery of the existing visible oil. Because the oil was in so many locations, it was impossible to quantify the amount of oil released without first recovering all of the oil in the plant, transformer and gate well. This underestimating of the event delayed and hindered the response by all parties involved.
- Staff should have stated the maximum possible release (worst case) was 5500 gallons and that most of it was contained. They should then have worked backwards to reduce that number.



**Mitchell Samuelian**  
**U.S. Bureau of Reclamation, Denver, CO**



**Gary Sanford**  
**Bonneville Power Administration, Portland, OR**



**Jim Blankenship.**  
**U.S. Bureau of Reclamation, Glen Canyon Dam, AZ. (retired)**

**Attachment:**

**Documents Reviewed:**

- Plant operator logs 8/29/03
- Plant operator logs 1/15-17/04
- Journeyman duties Jan 04
- Ambient temperature Jan 04
- Clearance order #03-0444
- Clearance order #03-0442
- Oil analysis sheet 7/23/03 #0070020
- Spill Emergency Notification checklist 1/15/04
- Mass Balance Calculation T2B
- Journey shift operator routine duties
- Transformer log sheets

**Persons Interviewed:**

Jim Dennis	Environmental Protection Specialist
Richard Harrison	Operations Superintendent
Terry Armetrout	The Dalles Plant Manager
Dan Slead	Electrical Crew Supervisor
Doug Walton	Electrician
Dan Heister	EPA
Mark Layman	Washington State Dept of Ecology
Mike Renz	Oregon Dept of Environmental Quality